

Course Summary

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mathematical optimization

- ▶ problems in engineering design, data analysis and statistics, economics, management, . . . , can often be expressed as mathematical optimization problems
- ▶ techniques exist to take into account multiple objectives or uncertainty in the data

tractability

- ▶ roughly speaking, tractability in optimization requires convexity
- ▶ algorithms for non-convex optimization find local (suboptimal) solutions, or are very expensive
- ▶ surprisingly many applications can be formulated as convex problems

theoretical consequences

- ▶ local optima are global
- ▶ extensive duality theory (systematic way of deriving lower bounds on optimal value, necessary and sufficient optimality conditions, certificates of infeasibility, sensitivity analysis)
- ▶ solution methods with polynomial worst-case complexity theory (with self-concordance)

practical consequences (convex problems can be solved globally and efficiently)

- ▶ interior-point methods require 20 – 80 steps in practice
- ▶ basic algorithms (e.g. Newton, barrier method, ...) are easy to implement and work well for small and medium size problems (larger problems if structure is exploited)
- ▶ more and more high-quality implementations of advanced algorithms and modeling tools

Using convex optimization

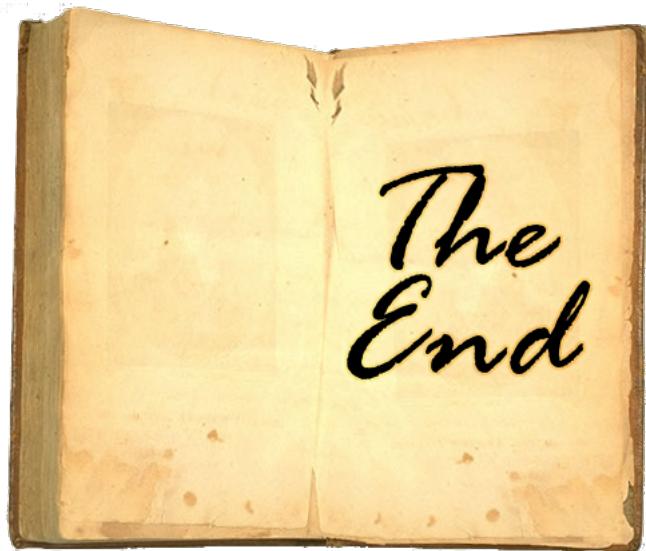
areas of applications

- ▶ approximation and fitting
- ▶ statistical estimation
- ▶ geometric problems
- ▶ ...and many more

general guidance for using convex optimization

- ▶ use rapid prototyping, approximate modeling
- ▶ work out, simplify, and interpret optimality conditions and dual
- ▶ even if the problem is quite non-convex, convex optimization can still be helpful





Teaching evaluations

Feedback or suggestions